REEVES

THE WORLD-STORY

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THE WORLD-STORY
OF 3000,000,000 (?) YEARS

By
J. REEVES
(Former Research Scholar in Biology, Royal College of Science)

WITH A FOREWORD BY
PROF. J. ARTHUR THOMSON, M.A., LL.D.

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FOREWORD

By Professor J. ARTHUR THOMSON, M.A., LL.D.

I have seen and studied the interesting charts prepared by Mr. Reeves, and it gives me much pleasure to have an opportunity of expressing my admiration of their vividness and scholarship in so far as they deal with the history of the earth and its living creatures.

Of those dealing with human history I am not qualified to speak; to me as a learner they make a strong appeal. The early charts I have scrutinized with some care and I cordially recommend their publication.

From prolonged educational experience and experiments I am convinced of the value of historical charts and graphic devices of all kinds; and I believe far-reaching consequences will follow the use of vivid presentations of this sort.

AUTHOR'S PREFACE

During recent years the view has arisen, and is evidently growing, that one of the principal aims of study should be acquisition, by all, of some general, if elementary, knowledge of World-Evolution, of the whole course of World events, their nature, order and connection.

The tendency to take a wider and larger range in the writing of history is shown by various works which have appeared during the last decade or two; but the most systematic attempt to cover the whole ground of World-History is the now famous *Outline* of Mr. H. G. Wells, which began to appear when the present work was nearing completion, and treats in a magnificent narrative the ages that are here dealt with, much more briefly, in the form of charts.

The importance of the use of charts, emphasized by Prof. Thomson in the Foreword, has been pointed out by other leaders of thought, and reference may be made to Hayward and Freeman's *Spiritual Foundations of Reconstruction*, Chapter VII, and to the prefatory notes contributed by various writers to that book.

The aim of the present series is to present, as briefly and graphically as may be, a simple, continuous view of World-Evolution for reading and reference. Historical Charts have long been in use, but, so far as can be ascertained, the earlier ages have not been dealt with continuously, and the form of these charts is new.

I have tried to indicate the leading features by means of headlines, but the main series of events appear in the numbered columns.

In the selection of items general preference has been given to those features which appear to be of cardinal importance from the evolutionary point of view, and in chart 6 to those which indicate intellectual and social progress; but some other features of interest or significance have been included.

The charts and columns are, of course, to be regarded as strictly sequential—except that some overlapping at two points (charts 3–6) was found to be necessary in order to keep the size of the charts within reasonable limits—and the divisions into ages, periods, etc., though useful as landmarks, do not indicate any breach of continuity. It has to be noted, also, that the astronomical and geological eras have not come to an end, but are still proceeding, and that the prehistoric, or nonhistoric, stage still persists in various parts of the world.

The dates given in charts 1 to 5 must be regarded as provisional, approximate or doubtful in many cases. They are based on estimates and calculations which have appeared in recent publications of physicists, astronomers, geologists, archæologists and others. In the case of the historical period also (chart 6) the dates of many events are still questionable or unknown. To this it must be added that some events, including inventions, were gradual and cannot be definitely dated. The sequence of events is, however, fairly known, and this has been regarded as of more importance than exact dating.

It need hardly be said that no single individual can claim authoritative knowledge of all the periods brought under review. I have therefore taken the great liberty of making free excerpts from the writing of competent authors in support of many of the included items. To these an expression of deep indebtedness is due. Apologies are also due for the slight modifications of some passages, which, however, have been made only in accordance with more recently acquired knowledge, or more recent conclusions, communicated to me by those possessing authoritative knowledge on the points concerned.

I have to record thanks for much friendly aid: to Prof. Fowler, F.R.S., for reading Chart 1; to Dr. Davies for giving much help with Charts 2 and 3; to Mr. Reginald Smith, F.S.A., for reading Charts 4 and 5; to Dr. Hayward and others for reading the whole or part of Chart 6. But above all, grateful thanks are due to Prof. Thomson for his generous and extended help.

It cannot be hoped that the charts are free from errors—of detail, of judgment in the exclusion, selection and statement of events—but only that such errors will not substantially affect the general view that is presented.

It is hoped that the charts may be published at some future date in a larger form —inclusive of a general chart, as suggested by Mr. H. G. Wells—so that they may be suitable for use as wall-charts.

BIBLIOGRAPHY

"Books are the World's Memories."—(Aldis.)

The following books, among others, have been used in preparation of the charts, and many of them are referred to by number in the charts and notes, thus : (24, p. 57). Most of them are small and inexpensive. The few larger, more advanced or expensive works are marked *.

"H.U.L."=Home University Library (Williams and Norgate); "C.M."= Cambridge Manuals of Science and Literature (Cambridge University Press); "P.B." =The People's Books (T. C. and E. C. Jack). The cost of these books before the war was sixpence to one shilling each. The original price, so far as this is ascertainable, of some other books is given below.

1. Lockyer, *Elementary Lessons in Astronomy* (Macmillan), 3*s.* 6*d.*
1a. Hinks, *Astronomy* (H.U.L.).
1b. Maunder, *The Stars* (P.B.).
1c. Maunder, *Sir W. Huggins* (P.B.).
2. Gregory, *The Making of the Earth* (H.U.L.).
2a. Holmes, *The Age of the Earth* (Harper), 2*s.* 6*d.*
*2b. *The World We Live In* (Waverley Book Co.).
*2c. Lull, *The Evolution of the Earth* (Yale University Press).
*3. Geikie, *Class Book of Geology* (Macmillan), 4*s.* 6*d.*
3a. Marr, *Principles of Stratigraphical Geology* (Cambridge University Press), 6*s.*
4. Thompson and Geddes, *Evolution* (H.U.L.).
*4a. Lull, *Organic Evolution* (The Macmillan Co.).
5. Goodrich, *The Evolution of Living Organisms* (P.B.).
5a. Scott, *The Evolution of Plants* (H.U.L.).
6. Smith, *Primitive Animals* (C.M.).
7. Keith, *The Human Body* (H.U.L.).
7a. Leighton, *Embryology* (P.B.).
*7b. Hobhouse, *Mind in Evolution* (Macmillan).
7c. McDougall, *Psychology, The Study of Behaviour* (H.U.L.).
*8. Osborn, *Men of the Old Stone Age* (Bell & Sons).
9. Duckworth, *Prehistoric Man* (C.M.).
10. Munro, *Prehistoric Britain* (H.U.L.).
11. Marett, *Anthropology* (H.U.L.).
12. Sir E. Ray Lankester, *The Kingdom of Man* (cheap ed., Watts & Co.), 6*d.*
12a. Myers, *The Dawn of History* (H.U.L.).
13. Marvin, *The Living Past* (Clarendon Press), 3*s.* 6*d.*
13a. Breasted, *The Origins of Civilization* (The Science Press).
*14. Breasted, *Ancient Times* (Ginn & Co.), $1.60.
*15. Robinson, *Medieval and Modern Times* (Ginn & Co.), $1.60.
15a. Marvin (ed.), *Progress and History* (Oxford University Press).
15b. Bury, *History of Freedom of Thought* (H.U.L.).
*16. Ward, *Pure Sociology* (Ginn & Co.).
*16a. Ward, *Applied Sociology* (Ginn & Co.).

The British Museum Guides, very cheap and well-illustrated books : most of them cost 1*s.* each :—

17. *Fossil Invertebrate Animals.*
18. *Fossil Reptiles, Amphibians and Fishes.*
19. *Fossil Mammals and Birds.*
20. *Fossil Remains of Man*, 1918, 6*d.*
20a. *The Races of Mankind.*
21. *Stone Age Antiquities.*
22. *Bronze Age Antiquities.*
23. *Early Iron Age Antiquities.*
24. *Egyptian Antiquities.*
25. *Babylonian and Assyrian Antiquities.*
26. *Greek and Roman Antiquities.*

The Horniman Museum (Forest Hill) Handbooks, useful publications costing from one to a few pence each :—

27. *From Stone to Steel.*
28. *Evolution of the Domestic Arts*, Parts I and II.

29. *Discovery*, "A monthly popular Journal of Knowledge," 6*d.*
30. *Nature, Jubilee Number*, November 16, 1919.
*31. Wells, *The Outline of History.*

INTRODUCTION

The whole succession of men during the ages should be considered as one man, ever living and learning (Pascal).

Changing order, orderly change, and this everywhere—in nature inorganic and organic, in individual and in social life—for this vast conception . . . we need some general term—and this is Evolution . . . Evolution in astronomy, from Kant to Lockyer; evolution in chemistry and physics; . . . evolution in geology, from Leonardo and Palissy to Lyell and Darwin and onwards—all these large retrospects of the history of science are needed for a grasp of cosmic evolution (Thompson and Geddes, *Evolution*).

Earth-history like human history is the record of an unbroken chain of events. . . . Accordingly a perfect earth-history would be written as a continuous narrative, just as would a complete history of the human race (Marr, *The Principles of Stratigraphical Geology*).

It has become more and more a matter of conviction to me . . . that the time has arrived when the true relation of Nature to Man has been so clearly ascertained that it should be more generally known than is at present the case. The consensus is complete: Man is held to be a part of Nature, a product of the definite and orderly evolution which is universal (Lankester, *The Kingdom of Man*).

With Darwin, then, we anthropologists say: Let any and every portion of human history be studied in light of the whole history of mankind, and against the background of the history of living things in general . . . the same kind of history, with the same evolutionary principle running right through it, for all men, civilized and savage, present and past (Marett, *Anthropology*).

The new discoveries enable us to plan out the vast tract of geologic time, compared with which historic time is but a minute in a day, and in rough outline to sketch the main features of human development which were laid down for all the sequel in those unnumbered millenniums of pre-history . . . and with the study of the past in all its forms our interest in the future has been immeasurably enhanced. . . . By studying the past and coming to understand the laws of its evolution, each generation acquires greater power as well as more desire to control the future (Marvin, *The Living Past*).

Chart 1. I. THE ASTRONOMICAL

The Tidal Theory of the origin of the Solar System suggests two epochs: (1) during which our hypothetical formation of our Solar System; (2) from the formation of

Nebular-Stellar Epoch.

Column 1.

Nebulæ, from which, possibly, Stars and Solar Systems are Formed.

Evolution in Astronomy.—Further observation soon convinced me that . . . the probability is indeed overwhelming in favour of an evolution in the past and still going on, of the heavenly hosts. . . . There remained no room for doubt that the nebulæ, which our telescopes reveal to us, are the early stages of long processions of cosmical events, which correspond broadly to those required by the nebular hypothesis in one or other of its forms (Sir W. Huggins, quoted in 1c, p. 81).

Nebulæ are of various shapes—irregular, spiral, annular, elliptical, etc. The most powerful modern telescopes render visible about half a million. Two can be seen by the naked eye on a clear, dark night as faint, luminous patches in the constellations Orion and Andromeda. Some of the nebulæ are gaseous.

1. **Primary or Primitive Nebulæ.**—It is now a widely accepted view that gaseous nebulæ condense into stars, such as the "Ancestral Star" or "Ancestral Sun" of our solar system (cols. 2 and 3).

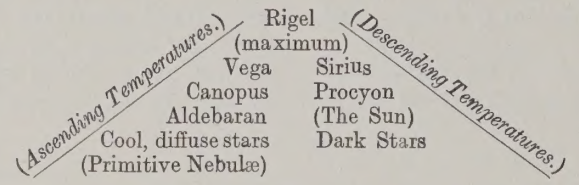
2. **Spiral Nebulæ.**—These may belong to a later stage of evolution. Hundreds of thousands of them are known. A spiral nebula consists of a central mass from which arms, usually two, emerge at opposite points and wind about the centre (1a, pp. 208, 218). According to the planetesimal hypothesis, a spiral nebula is regarded as a stage in the evolution of a solar system.

The earlier forms of the Nebular Hypothesis—of Kant, Laplace, Lockyer and others—have been superseded by more recent forms.

Column 2.

Stars Cool Down, after Attaining a Maximum Temperature (our Sun is regarded as a Partially Cooled Body). Dark Stars.

It is now concluded that stars are hot, cold and of intermediate temperatures. In 1888 Lockyer made a distinction between stars of rising and diminishing temperatures. Beginning with a primitive nebula, the body which forms by condensation will at first become hotter, attain a maximum temperature, and finally cool. They have been to some extent classified on this view:—



Giant and Dwarf Hypothesis.—Stars of the ascending series (Giant stars) are regarded as enormous masses of extreme tenuity, which become heated by contraction, until, owing to increase of density, they lose the completely gaseous condition at the time of maximum temperature and brightness. They continue to contract and become smaller in volume (Dwarf stars), but the temperature falls, and this continues until they become cold masses. (This view has received support in many ways and is now widely accepted.)

Dark Stars.—Sirius and other bright stars have dark, cool or cold, companions. Some are invisible, but are known by their effect on their bright companions—

Algol—and others of the "Algol Type"—consists of a bright and a dark star. The brightness of the former is variable; and it is now fully established this variability is due to a partial periodical eclipse of the bright by the dark member of the system (1a, p. 177).

As regards the stars, the spectra of many of them have been photographed in great detail for minute analysis and a multitude more for purposes of classification . . . the impressive result is that the different types of stars are not to be looked upon as arising from fundamental differences of composition, but as representing successive stages in an orderly evolutionary progression (30, p. 235).

Solar-Planetary Epoch.

Column 3.

BIRTH OF OUR WORLD—The Planets Separate from the Sun (3000,000,000 Years Ago?).
(Date based on astronomical considerations, *see* 29, April, 1920, p. 112.)

Of one fact we can be sure: the earth was originally part of a much larger and less compact mass, from which came all the other members of the Solar System.

As the eight major and the five hundred minor planets (Planetoids or Asteroids) move round the sun, and the moons, with few exceptions, round their planets, in the same direction, it has been estimated that the odds against this uniformity of movement being due to any other cause than that all these bodies were once part of one body that was spinning around its centre, are many billions of billions of billions to one (2, pp. 10–14).

Formation of the Solar System.—The mode of formation is still in the domain of theory. The most successful explanation appears to be the *Tidal Theory*:—

Planetesimal Hypothesis.—A very large star closely approached our own ancestral star, and the intense gravitational pull caused partial disruption. Two streams of matter shot out and a spiral nebula resulted. The planets were formed from the planetesimals or portions of the spiral arms, by condensation around denser points (the "nebular knots"), while the central portion formed the sun (2a, pp. 28–30).

According to another recent form of the Tidal Theory, the separation of a portion, in the form of a filament, occurred while the star was still gaseous, and from the break-up of this filament the planets resulted. The passage of the larger star would give to the filament, and therefore to the planets, a motion of revolution round the central sun. The moons may have been formed at the same time, or at a later date by separation of portions from the planets (29, May, 1920, pp. 135–7).

The Planetoids (Asteroids), which are commonly thought of as cold bodies, though nothing is known of their surfaces, and the rings of Saturn may have been due to the break-up of planet or satellite.

ERA. Advance to a HABITABLE GLOBE and to LIFE

Nebula and Ancestral Star ran its course, perhaps for "untold ages," until its partial disruption resulted in the the Solar System to the present day (*see* 2c, Chaps. I, II).

Column 4.

Sun, Planets and Moons Cool Down. THE EARTH GAINS A SOLID CRUST.

In general the rule appears to hold good throughout the solar system that a very large body is intensely hot and in a condition of violent activity and rapid change; that smaller bodies are less hot and less active until we come down to the smallest, which are cold, inert and dead (1b, p. 79).

The Sun, which has a volume of more than 1,000,000 times that of the earth, cools slowly. It is still surrounded by a photosphere or "fire cloud," consisting of cloudlets in rapid motion owing to the continual rush of hot currents, at a temperature usually considered to be about 6,000° C. (1a, pp. 39, etc.).

The Outer (Major) Planets.—Jupiter, Saturn, Uranus, Neptune—which are from 65 to 1,304 times the size of the earth—are evidently intermediate in temperature as they are in size. The changes observed on Jupiter—"rushing winds and hurrying clouds"—indicate a heated condition, and spectroscopic observation indicates that the outer planets still emit some light of their own (1c, p. 36).

The Earth, a comparatively small body, would cool more quickly, but it still contains heated matter within, as is shown by volcanic and other phenomena; and the remaining Inner (Minor) Planets—Mercury, Venus and Mars—are presumably in a more or less similar condition.

The Moon—a much smaller body, about $\frac{1}{50}$ of the size of the earth—would cool still more rapidly, and is commonly regarded as a cold body, though recent research gives indications that it is not yet completely changeless and "dead." That it was once hot is indicated by the huge craters, rifts, etc., on its surface, which seem to be due to violent volcanic action (29, October, 1920, pp. 302–3).

Whether the Earth, as a separate body, was at first molten throughout or not, the outer parts would probably be at, or reach, a melting temperature; and the lighter stony materials would rise to the surface while the heavier metallic substances sank below, just as in a furnace the slag rises to the top while the iron sinks to the bottom.

The Crust of the Earth would therefore be formed of rocks that solidified like a slag from the molten state (2, p. 62).

Column 5.

Oceans and Atmosphere are Formed. Rains and the Primal Streams Appear.

Oceans and Atmosphere.—While the earth was hot, the water which then existed at the surface must have been in the form of steam or vapour; but as cooling proceeded the vapour would condense into liquid and accumulate on the surface. The water may have covered the whole crust at first; but sooner or later upheaval and depression, due to shrinkage and buckling of the original crust, would result in the formation of lower areas, in which the water collected, and the primal land and ocean areas would be formed.

In the course of such condensation rain would probably be formed in the upper and cooler regions of the atmospheric blanket, and as it fell it would be vaporized. On further cooling, rain would reach the hot surface and be sent flying back as gas or steam. At a later date the water would remain in liquid form, and, following on the formation of the oceans, the primal streams would be formed (2c, Chaps. I, II).

The Atmosphere and Oceans must have been derived from the materials of the earth itself. Even now the outer 70 miles of the crust would be sufficient to supply the nitrogen, the water, and the carbon dioxide represented by the limestones and carbonaceous deposits (2a, pp. 30–31).

It seems probable that there was little free oxygen in the early atmosphere, and that this element was gradually supplied by the activities of green plants, which split up the carbon dioxide of the air and use the carbon content to build up nutritive compounds. Much of the oxygen is also used by the plants for respiration, but a little is left over, and from its accumulation the greater part of the 1100,000,000,000,000 tons in the present-day atmosphere has resulted (2b, p. 47).

Column 6.

LIFE APPEARS. Sunshine Begins on Earth, Climate Develops, Geological Action Proceeds.

On the early earth . . . the surface was warm and moist, the atmosphere thick and dense, and the temperature probably almost the same, night and day, all the year round (2, p. 229).

Compare the present condition of Jupiter—

If Jupiter has a solid surface . . . it must be sunk so deep in the cloud envelope that the rays of the sun can never penetrate there. . . . The outer planets seem to belong altogether to a more primitive age, such as that which the smaller planets passed through long ago (1a, pp. 72, 73).

Life would probably have begun when the earth had a dense atmosphere, heavily laden with carbon dioxide and water vapour (2, pp. 222–3).

The Origin of Life is an unsolved problem—

But we must admit that as an hypothesis the doctrine of the origin of the living from the not-living is in harmony with the general trend of the evolution theory (4, p. 72).

As the atmosphere became clearer, owing to further condensation of the water vapour of the envelope, and more readily penetrable by the sun's rays, sunshine would appear; parts of the earth's surface would become preponderantly heated, planetary wind systems and other factors of climate would arise and geological action would proceed (2c, Chaps. I, II).

Chart 2. II. THE GEOLOGICAL

Formation of the Stratified Rock Systems, with Included Fossils. Evolution of Plants

ARCHÆOZOIC EPOCH (Dawn of Ancient Life).

Column 7.

Lowly Aquatic Plants and Animals only Exist. The Beginnings of Death, Sex and Brains, Upheaval of the British Area.

PRE-CAMBRIAN PERIOD (Archæan and Algonkian).

From 1600,000,000 to 660,000,000 years ago ?

Evolution in Geology and Biology.—With the existence of an ocean and an atmosphere denudation and sedimentation began—

1. The breaking and wearing down of the primal surface rocks of the earth's crust;
2. The deposition of the material in the seas. Embedded in the resulting strata or layers of rock are found the remains of plants and animals which existed when the sediments were being deposited.

Rocks of this period intensely crumpled in all parts of the world. Widespread and violent volcanic action—in England at Charnwood Forest, Malvern Hills, etc. (2, pp. 162–5).

Owing to the great alteration of the rocks by heat, pressure, movement, etc., through long ages, and the absence in the lowly plants and animals of hard parts capable of preservation, fossils are not certainly recognizable. But some remains have been assigned to the period (4a, pp. 87, 90).

It is now established that the earlier organisms lived in the water. Relics of the aquatic state are well known in the higher animals, including man.

Thus in the development of every reptile, bird and mammal there are residues of gill-cleffs, sometimes imperfectly opening, which have no respiratory significance whatever. . . . There are no known interpretations of these except as **recapitulations** of the respiratory apparatus of remote aquatic ancestors.

From this point of view (vestigial structures) our own body is a " veritable museum of relics " (4, pp. 47–59).

During this period many notable features would appear—

The Beginnings of DEATH, of SEX and of BRAINS.—(4, Chap. III).

Upheaval of the land ; the British area, part of which had been under the sea, arose, and the *First Continental Period* established. (Four such periods, with intervening *Marine Periods*, have been detected in the *British Area* ; 3a, Chap. XIII).

A. **Age of the Rocks—Radio-activity.**—This process consists in the breaking down (atomic disintegration) of such substances as uranium and thorium, with the production of helium and lead—

Every radio-active mineral is like a clock ticking out its age as the uranium and thorium within it gradually disintegrate. Helium and lead accumulate ; but the former, a gas, escapes ; and the " Helium-ratio " gives an age of less than one-half that of the " Lead-ratio " in various cases. The latter appears to be more nearly the true age. From such calculations the dates given in Charts 2 and 3 follow (" A " in Charts 2 and 3).

The greatest age indicated is about 1600,000,000 years (2a, Chaps. VII, X, XI).

The Maximum Thickness of the rocks, as estimated by Professor Sollas, is also given (" M.T." in Charts 2 and 3).

A. 1600,000,000 years. M.T. Archæan ? Algonkian 82,000 feet.

PALÆOZOIC EPOCH (Primary).

Column 8.

Seaweeds. Animals without Backbone, Including Molluscs (" Shell-Fish "). British Area Submerged.

CAMBRIAN PERIOD.

Plants.—Seaweeds (Algæ).

Animals.—All the main groups of aquatic invertebrates in existence—

9. Molluscs.
8. Lamp Shells.
7. Crustaceans.
6. Trilobites.
5. Worms.
4. Starfishes.
3. Corals.
2. Sponges.
1. Protozoa.

The rise of the bivalve molluscs illustrates the advance and increase of animal races.

A few ill-preserved shells appear in the Cambrian rocks of Wales ; they are still rare in the Ordovician ; in Silurian times a score of families existed, mostly with shells of simple type ; in the Devonian brackish and freshwater forms appeared, increasing in Carboniferous times ; older forms disappeared and new ones came in in the Triassic and Jurassic periods, and Tertiary forms show a gradual change to the present day character and distribution of these animals (17, pp. 126–7).

At about the beginning of this period extensive depression brought about the submergence of the British area, and the **First Marine Period** began, which continued, with local elevations and volcanic activity, until Silurian times.

A. ?
M.T. 26,000 feet.

Column 9.

As in the Former Period, with Indication of Land Plants and Vertebrates.

ORDOVICIAN PERIOD.

Plants—not well known, but probably seaweeds and some dubious evidence of land plants.

Animals.—Some evidence of the earliest backboned animals or their immediate forerunners (4a, pp. 86, 91).

The earliest chordates, predecessors of the vertebrates proper, would lack bony parts capable of fossilization, and their remains are wanting or fragmentary.

Compare the existing lanceolets, which undoubtedly represent in many features a primitive or ancestral chordate (6, pp. 77–8). They possess a stiffening notochord or spine running as a support along the dorsal region of the body, but no bony skeleton, no skull or differentiated brain, and belong to the Acrania or skull-less group. The lowest Craniata or skulled group, the Hog-fishes and Lampreys, are without jaws (compare the fossil forms, col. 10).

Renewed and intense volcanic action—in Wales, the Lake District, Scotland. An enormous mass of volcanic and sedimentary material was built up in North Wales, of which a small remaining part now forms Snowdon (2, p. 167).

A. ?
M.T. 17,000 feet.

ERA. Advance to SEED-BEARING PLANTS, BACKBONED, AIR-BREATHING ANIMALS

and Animals in Ascending Series (most of the ancient types of these epochs are now extinct).

Column 10.

Fresh Water Animals. Land Invertebrates—Insects. VERTEBRATES APPEAR—Uplift of the Land. Britain again Raised from the Sea.

SILURIAN PERIOD.

Plants—as in the preceding period; some well-preserved seaweeds.

Animals—Fishes; primitive fish-like forms, with skin armour, but without bony skeleton, ordinary lower jaw or paired fins representing limbs.

Insects appear, including some related to the modern Cockroach. Scorpions. Sea-lilies.

Upheaval of the land in some regions and toward the close of the period a large part of the British area emerged from the ocean and the *Second Continental Period* began.

Palæontologists now connect geological and biological changes and draw conclusions as to the impelling forces underlying great evolutionary steps.

The Silurian uplift of the land would be followed by the dwindling of rivers, with the formation of residual water-holes and swamps. These would tend to dry up at certain times of the year; the water would become short of oxygen; and these conditions would favour, through natural selection, any variation toward the air-breathing habit and lead toward the evolution of the lung (4a, pp. 688, etc.)

A. (Ordovician to Silurian) 430,000,000 years.
M.T. 15,000 feet.

Column 11.

Seed-bearing Plants. Lung-Breathing Fishes. The Early 3-Toed Foot ?

DEVONIAN PERIOD.

Plants.—Land plants, some probably seed-bearing, ferns and other cryptogams, also the older, recently discovered "Psilophyton Flora"—*Rhynia*, a simple land plant without roots or leaves; *Asteroxylon*, more advanced, with small, simple leaves.

Animals.—Fishes, including air-breathing forms (Dipnoi). Such air-breathing or lung fishes still exist. Some jump about on coral reefs or creep over the sand and mud. The Climbing Perch of Ceylon can ascend trees by the help of spines growing out of its gill-covers.

In the Dipnoi the air-bladder of the fish has become a lung. The Dipnoi, both in the nature of their lungs and in their skull, betray their relationship to the primitive group of fishes which gave origin to the land vertebrates (6, pp. 93–107).

There is now some indication of the early stages of evolution of the toed limb of the terrestrial vertebrate. In Sauripterus, a Devonian fossil fish, the bony structure of the limb is apparently foreshadowed; and a single footprint—of a foot with two toes and a third "bud"—has been recorded in the Devonian rocks. Such "budding" of the toes is discernible in the individual development of the limb of the existing Salamander (4a, pp. 488–90); and, in accordance with the principle of recapitulation, this is to be regarded as indicating the mode of its evolution in the race.

A. 390–360,000,000 years.
(Helium-ratio, 145,000,000 years.)
M.T. 22,000 feet.

Column 12.

Amphibians Appear. The First Voice ? The 5-Toed Foot.

CARBONIFEROUS PERIOD.

Plants.—Many seed-bearing plants (Pteridosperms); huge trees of the Lycopod and Equisetum groups.

The palæozoic seed-ferns have since disappeared and the great Lycopods and Equisetums are now represented by the smaller Clubmosses and Horsetails of the present day (5a, pp. 155, 238).

Animals.—Amphibians appear and become the dominant group.

The 5-toed Foot appears—The Stegocephalia, the first land vertebrates with ordinary limbs, always with a "Pineal Foramen," an opening in the top of the skull from which a median eye looked out. Such an eye is found, though not in a fully functional condition, in the existing reptile *Hatteria* (*Sphenodon*) (see col. 13), and the foramen occasionally appears in man, together with other apparent vestiges of the median eye (4a, p. 662).

Insects.—Dragon flies, with spread of wing up to 29 inches; Spiders.

Huge swampy forests of gigantic trees were submerged and have formed the main part of our coal.

Arthur's Seat, near Edinburgh, "built up" by a great volcano (2, p. 169).

The First Voice.—As pointed out by Professor J. A. Thomson, the long silence of the animal world—so far as vocal organs were concerned—would probably be broken by the voice of amphibians, the earliest animals possessing vocal cords and a movable tongue, possibly in this period. The further evolution of vocal organs, voice and speech would subsequently proceed through the mammalian series until the fully formed

Column 13.

Gymnosperms. Reptiles. Permian Glacial Period. Ural Mts., Pennine Chain Upraised. Desert in Britain.

PERMIAN PERIOD.

Plants.—Gymnosperms, including Coniferæ, and primitive seed plants of classes now unknown (5a, p. 25).

Animals.—Reptiles, but not clearly differentiated from the amphibians at first.

The earliest reptiles so closely resembled the primitive amphibians that it is difficult to say where one class begins and the other ends (5, p. 97).

Hatteria (*Sphenodon*) an ancient reptile which still exists, a "living fossil," the sole survivor of an important group of Carboniferous to Permian times (see col. 12).

At this time the ocean probably shrank to its narrowest limits, forming mainly a ring around the world between a northern and a southern continent. The latter probably extended from Australia, through India and South Africa to South America (2, pp. 182–4), and a great glacial period occurred.

On the northern continent there were large inland seas in which salt deposits were laid down, as they are in the Dead Sea and Great Salt Lake at the present day. Desert conditions existed in Britain.

Earth movements of Permian and Triassic times raised the Pennine Chain, Mendip Hills, Ural Mountains, etc.

A. (Carboniferous to Permian) 340,000,000 to 300,000,000 years.
M.T. 12,000 feet.

(*Continuation of Column 12.*)

organs and articulate speech of man appeared (col. 27).

A. 340,000,000 years.
(Helium-ratio 147 to 146,000,000 years.)
M.T. 29,000 feet.

Chart 3. II. THE GEOLOGICAL

Continued Evolution of Plants and Animals. (They gradually

MESOZOIC EPOCH (Secondary). Reptiles Dominant ("Age of Reptiles").

CAINOZOIC EPOCH (Tertiary).

Column 14.

Seed Plants (still Flowerless). MAMMALS APPEAR. Following on continued Desert Conditions, the British Area again Sinks Beneath the Sea.

TRIASSIC PERIOD.

Plants.—Gymnosperms and Cycadaceous plants dominant; these replaced the seed ferns and abounded in every part of the world, though now a small and isolated family (5a, p. 116).

Animals.—Mammals, lowly archaic forms, apparently allied to the lowest existing, egg-laying group, e.g., the Australian Duckbill.

The Theromorph reptiles of the Trias so nearly approach the mammalian type of structure in various directions that they are now generally held to have been, if not the ancestors themselves, at all events closely allied to them (5, p. 101).

Reptiles become "Lords of the Earth"—huge land and aquatic forms; and in this or the following period flying reptiles appear, with well-fitting joints and hollow bones like those of existing birds.

More modern forms of insect appear—Flies, Ants.

The hairy covering of the body was perhaps evolved when the mammalian stock was emerging from a primitive scale-covered ancestry, the hairs at first being produced under the scales, as may still be seen in lowly existing mammals, such as the Armadillo (7, p. 206).

Continuation of desert conditions in Britain and deposition of what now form our main British supplies of salt in later Triassic times.

Towards the end of the period the British area was submerged and the *Third Marine Period* began, lasting, with local interruptions, through Jurassic and Cretaceous times.

A. ? M.T. 17,000 feet.

Column 15.

Links between Flowerless and Flowering Plants. Links between Reptiles and Birds.

JURASSIC PERIOD.

Plants.—The Bennetitales ("Pro-Angiosperms") appear, with primal "flower" on the same general plan as the Angiosperms or true flowering plants. The primitive fruit, with case enclosing the seed, appears in the Mesozoic Cycadophytes (5a, p. 88).

Gingko biloba, the Maiden Hair tree of Japan, a "living fossil," the last survivor of an ancient Mesozoic family; common in Britain in this period; recently introduced as an ornamental tree, perhaps 200,000,000 years after its extinction in this part of the world (5a, pp. 57–8).

Animals.—Mammals of the next higher group, early Marsupials (Kangaroo, etc., group). The existing Marsupials produce living young.

Archæopteryx, the bird-reptile, one of the best known animal "links"—a bird with teeth in both jaws, a long bony tail and wings ending in unmistakable claws (4, p. 34).

Reptiles still dominant. *Diplodocus*, 84 feet 9 inches in total length. More familiar reptiles, the early crocodiles. Bird-footed reptiles, with feet and other characters resembling those of birds.

More familiar forms of fish appear. Early Crabs, Lobsters.

Higher insects—Bees, Butterflies—appear about this time; and the evolution of flowers, in respect of variety of form, colour and perfume has since, no doubt, proceeded along with the evolution of the higher insects, which obtain food from the flowers and are intimately concerned with their fertilization (5a, pp. 42–3).

A. ?
M.T. 8,000 feet.

Column 16.

FLOWERING PLANTS APPEAR. True Birds. Extension of the Seas: much of Western Europe and of Britain Submerged.

CRETACEOUS PERIOD.

Plants.—Ordinary flowering plants appear (Angiosperms)—Beech, Oak, Ivy, Walnut, etc.

Plants now in existence—all the great groups except, possibly, No. 2.

5. Angiosperms, higher, ordinary flowering and fruiting plants.
4. Gymnosperms, without true flower or fruit, with naked seeds (Pines, etc.).
3. Vascular Cryptogams, higher spore plants, usually with stem root and leaf (e.g. Ferns).
2. The Bryophytes—Mosses and Liverworts—do not certainly appear in the earlier rocks and may have been evolved in later times (5a, p. 228).
1. Thallophytes, lower spore plants, without true stem, root and leaf (Algæ, Fungi).

Animals in existence—

5. Primitive Mammals.
4. Birds.
3. Reptiles.
2. Amphibians.
1. Fishes.

Invertebrates.

True Birds, flying and flightless, some with teeth and other persistent reptilian characters.

Iguanodon, a bird-footed reptile, walked on 3-toed hind limbs, as shown by "fossil footprints" in the rocks; its smaller fore-limbs ended in five "fingers" (18, pp. 23, 52).

Gradual extension of the seas over continental areas; large parts of England and Western Europe submerged and the great chalk strata deposited in an ocean of the *Third Marine Period*.

A. ? M.T. 44,000 feet.

Column 17.

Higher Mammals, Primates (Primitive Forms) Appear. The North British Area becomes Land.

EOCENE PERIOD.

70,000,000 years.

Plants.—Flowering plants common.

Animals.—Mammals of all the main orders but primitive types; Carnivores and Herbivores hardly differentiated at first.

Primates—remains of early tree-dwelling forest forms, essentially similar to lemurs (20, p. 4).

Early forerunners of the Horse—Eohippus, the "Dawn-Horse," with general proportions much like a fox-terrier dog; four-toed fore-feet, each ending in a hoof-like nail; three-toed hind-feet; with splint-like vestiges of fourth and fifth toes. The Horse and its relatives subsequently lost toe after toe until only the third remained, while they became taller and swifter, gained longer necks and larger brains (4, pp. 24–30). Elephants, Tapirs, Camels and other hoofed animals with five-toed ancestors have retained two to five toes.

Some mammals leave the land and return to the water; early Whale-like animals, Sea-cows.

Sea-snakes, python-like forms, probably up to 50 or 60 feet in length.

Fishes, closely related to present-day forms.

Reappearance of North Britain from the sea; the *Fourth Continental Period* begins. Climate of southern England probably subtropical.

Age of the Rocks.—Dates based on the lead-ratios (note to Chart 1) are not available for the Cainozoic periods except those given in columns 17 and 18.

A. 70,000,000 years.
M.T. 20,000 feet.

become less unlike and then much the same as existing forms.)

Mammals Dominant.

Column 18.

Early Monkey-like Animals. Greenland Separated from Europe.

OLIGOCENE PERIOD.

Animals.—Higher Primates, probable immediate predecessors of the Old-world Monkeys; Parapithecus, etc.

Various modern orders of quadrupeds appear in this and the following period—Lions, Tigers, Dogs, Bears, Rabbits, etc.; also Whales, following on the primitive whale-like creatures, with jaws bearing resemblances to those of reptiles of the Eocene.

Remains of the highest mammals, the Primates, are scanty. Monkeys, apes and men are remarkably wary and seem to have been little liable to those accidents by which ordinary quadrupeds are destroyed. The history of the former is being slowly revealed in scattered episodes and casual glimpses.

Families of mammals of this period persist to the present day, but no genera (20, pp. 3–4).

Climate in Britain still warmer than at the present day; the plants include Fig, Palm, Magnolia.

Volcanic activity in the British Area in Eocene and Oligocene times produced the lavas of Mull, Antrim, etc. The lava sheets of Iceland and Greenland were also formed at about the same time; and soon after the land bridge which connected Greenland with Europe was broken and submerged (2b, p. 55).

A. (Oligocene to Miocene) 30,000,000 years.

M.T. 12,000 feet.

Column 19.

Monkeys and Apes. The Alps and Himalaya Mountains Formed.

MIOCENE PERIOD.

Animals.—Anthropoid or manlike Apes; *Dryopithecus*, related to the Chimpanzee and Gorilla; *Pliopithecus*, an early relative of the Gibbon, probably erect or nearly so (7, p. 250; 20, p. 6).

Early Elephants, which can be traced back to smaller Eocene animals, with heads of more ordinary shape. *Tetrabelodon* followed with elongated lower jaw and with tusks in both jaws.

Toothed Whales, connecting modern forms with earlier types (19, pp. 70–1).

Great earth movements of Miocene and Pliocene times upraised the Alps, the Himalayas, the great western mountain chains of North and South America (the present great "backbone of the world") and the great chain of which the fragments stretching from Japan to New Zealand remain as the island festoons along the western shore of the Pacific (2, p. 189).

In the Eocene Period rapid enlargement of the relative size of the brain began among the mammals and it is not improbable that it was in the remote period known as the lower Miocene that Natural Selection began to favour that increase in a large and not very powerful semi-erect ape which eventuated, after some hundreds of thousands of years, in the breeding out of a being with a relatively enormous brain case, a skilful hand, and an inveterate tendency to throw stones, flourish sticks, protect himself in caves, and in general to defeat aggression and satisfy his natural appetites by the use of his wits rather than by strength alone (12, Chap. I, sec. 8).

A. ?

M.T. 14,000 feet.

Column 20.

The Ape-man (Pithecanthropus) Appears. Climate of Britain Grows Colder.

PLIOCENE PERIOD.

Animals.—*Pithecanthropus*, the "Ape-Man of Java," probably partially erect, with heavy brows, narrow forehead, flattened skull, and rather more than half the brain capacity of an average European—"A Caliban—a missing link" . . . (9, pp. 2–3).

Brain capacities—

1. Modern European (average) 1600 c.c.
2. Pithecanthropus (estimate) 900 c.c.
3. Apes (maximum) . . 600 c.c.

[It should be stated that there is still much controversy about Pithecanthropus, but, according to Lull, "the weight of authority considers it prehuman, though not in the line of direct development into humanity" (4a, p. 677).]

Earliest 1-toed horse, and a 3-toed horse from the Pliocene of India.

Elephants—*Mastodon*, with modern tusks and proboscis; but young individuals show very small tusks in the lower jaw, thus indicating connection with Tetrabelodon (19, p. 61).

Rhinoceroses, following on numerous ancestral types of Miocene and Oligocene times.

Deer, preceded by smaller ancestral forms, at first— (1) without horns, then (2) with small, simple horns, after which came larger animals with (3) larger and more complex horns. All these stages in the evolution of the horn are recapitulated in the individual development of existing deer (19, pp. 42–3).

Many genera of mammals of this period persist to the present day, but no species.

Climate growing colder.

More familiar plants—Willow, Poplar, etc.

A. ? M.T. 13,000 feet.

Column 21.

MAN APPEARS. Glacial Period. Great Britain Joined to the Continent.

PLEISTOCENE PERIOD.

This period, no doubt a comparatively short one, includes the Glacial Period, when large parts of Britain and Northern Europe were covered with sheets of ice as Greenland is now, and the advance of man is dealt with in Chart 4. In most respects the flora and fauna bear resemblance to those of the present day.

In Britain lived—

1. Arctic Fox, Reindeer; 2. Lynx, Grisly Bear; 3. Lion, Spotted Hyæna, Hippopotamus; and extinct animals formerly living in Britain include Sabre-tooth Tiger, Woolly Rhinoceros, Cave Bear and Mammoth (19, pp. 4–5).

The great groups of animals now in existence——

10. Primates { Man / Apes / Monkeys / Lemurs
9. Carnivora (flesh-eaters).
8. Insectivora (insect eaters).
7. Cheiroptera (Bats).
6. Ungulata (hoofed quadrupeds).
5. Rodentia (gnawing animals).
4. Sirenia (Whales, etc.).
3. Edentata (Ant-eaters, etc.).
2. Marsupials (Kangaroo, etc.).
1. Monotremes (Australian Duckbill, etc.).

Lower Vertebrates.

Invertebrates.

Man.—Starting with a progenitor whose mental and physical attributes were on a par with existing anthropoid apes, his successors have gradually forged their way into a new world, the world of ethics and responsibility (*Encyclopedia of Religion and Ethics*, Vol. I, p. 571).

A. ? M.T. 4,000 feet.

Chart 4. III. THE HUMAN ERA

Man becomes Dominant. In the wild and tribal stages he slowly

EOLITHIC EPOCH (Dawn of the Stone Ages).

Column 22.

FIRST HUMAN IMPLEMENTS ?

Relics from the Kent Plateau, etc.

No human skeletal remains have yet been found definitely assignable to this period, which appears to cover part of Pliocene as well as of Pleistocene time and may have lasted several millions of years.

Implements.—Very rough chipped flints (Eoliths) which many archæologists now believe to be the work of man.

It is pointed out that existing savage races make extremely rude tools; e.g. the Andamanese; and the Semang tribe may be said to have stone implements only in the sense that they pick up and use such convenient fragments as they chance to find (21, pp. 13–14).

It is presumed that man was at this time a wanderer, in the wild or lower savage condition, living precariously on fruits, nuts, roots, shell-fish, snails, and perhaps on small animals which he was able to kill with stones, wood or bone clubs, such as are used by existing uncivilized peoples.

The native Australians probably use at least 300 species of plants, eating the roots, tubers, pith, leaves, fruit, kernels, husks, seeds or gum (28, I, p. 12).

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1. **The great antiquity and the spread of primeval man** are now well established. Evidence of a Stone Age is found "all over the world." From Egypt, Somaliland, and many other distant lands come examples (of early implements) which Sir John Evans finds "so identical in form and character with British specimens that they might have been manufactured by the same hands" (11, p. 124).

2. **Evolution in Individual and Social Life.**—If we go back far enough in the story of man we reach a time when he had nothing whatever but his hands with which to protect himself, satisfy his hunger, and meet all his other needs. He must have been without speech and unable to build a fire . . . and every tool, however simple, had to be invented. . . . When he had learned to shape the stone to suit his needs, and thus to produce a rude tool or weapon, he entered what we now call the Stone Age . . . (14, Chap. I).

PALÆOLITHIC EPOCH (Old Stone Age).

Column 23 *and* 24.

ANCIENT MAN—Piltdown Race. Stone Implements.

PRE-CHELLES AND CHELLES PERIODS

(Pre-Chellean and Chellean).

500,000 B.C. ?

Sites at Chelles (France), etc.

Piltdown Man (*Eoanthropus Dawsoni*), the "Dawn Man," of very low degree, with primitive, ape-like skull, broad, with very thick roof, and a brain capacity estimated at 1,300 c.c. (compare brain capacities in Chart 3, col. 20); found in Sussex, with a very ancient type of flint implement; also fragments of a second skull (20, pp. 8–25).

Heidelberg Man—a jaw-bone (The Mauer Jaw), with human teeth, but massive, with a retreating chin approaching that of the ape; found near Heidelberg (Germany) (9, pp. 10–16).

For a recent account of fossil man in Europe, see 20.

Stone Implements—very crude, but doubtless made, or partly shaped, by man and improving in the Chelles period.

Hand Axe ("coup de poing"), a flint pebble sharpened at the end by chipping with another stone.

Scraper or Knife, a pebble sharpened at the edges.

In the river valleys of North-west France and South-east Europe, ancient implements are found in the higher terraces; these are the older deposits of the rivers which have since deepened their valleys.

The gravel in which Piltdown Man was found, rests upon a plateau 80 feet above the level of the River Ouse. The remoteness of the period is indicated by the subsequent deepening of the valley of the Ouse by (at least) 80 feet (10, p. 55).

Column 25.

Great Improvement in Stone Work.

ST. ACHEUL PERIOD (Acheulean).

Sites at St. Acheul (France), etc.

Stone Implements.—Some of excellent make and additional forms.

Hand axe—flat, oval and lanceolate forms (some perhaps used as dart and spear heads).

Approximate end of the "Drift Period." The "Cave Period" apparently began in Mousterian times. The climate, which was probably warm and moist in early palæolithic times, was growing colder, and man was driven to seek shelter in caves (10, pp. 89–90).

The remains of human bodies found to this point are few and were no doubt washed down and buried accidentally. With the beginning of human burial (col. 26) in late St. Acheul or in Le Moustier times remains become more frequent.

Column 26.

The Full Brain Appears—Neanderthal Man. Bone Implements Appear. Human Burial.

LE MOUSTIER PERIOD (Mousterian).

50,000 B.C. ?

Sites at Le Moustier (France), etc.

Neanderthal Race (*Homo Primigenus*), with full brain capacity, but low, retreating forehead, heavy brow ridges and chinless, projecting jaw; gait not fully erect; about 5 feet 4 inches in height; found at Neanderthal (Germany), Le Moustier (France), Spy (Belgium) and other localities (11, pp. 77–9).

Stone Implements more detailed, largely made from flakes struck off instead of from the main pebble, probably much used for scraping skins for clothing.

Bone Implements appear, but are rare in this period—Awl, Anvil.

Burial, with flint implements.

Continuity of Evolution of Brain and Mind.—Evidence of some rudiment of every mental function—unless it be conceptual inference, or reasoning in the stricter sense—is traceable in animal behaviour, including rudiments of the æsthetic and ethical conceptions.

Following on the simplest responses of the lowest plants and animals (*reflex action*), inherited *instinct* appears and reaches a high degree among insects; in the fishes *intelligence* (perceptual inference, with some power to learn and remember) can be detected; this educability increases through the mammalia and reaches a high degree among the apes (some have been taught to thread needles, skate, cycle and recognize numbers to 5). From this point we pass to man, with whom *reason* in the fuller sense appears (McDougall, *Psychology*; Lloyd Morgan, *Animal Behaviour*; Hobhouse, *Mind in Evolution*).

Column 27.

MODERN MAN APPEARS. Articulate Speech Begins ? Discovery of Fire Making. BIRTH OF ART.

AURIGNAC PERIOD (Aurignacian).

20,000 B.C. ?

Sites at Aurignac (France), Rock-shelter of Cro-Magnon (France), etc.

Cro-Magnon Race (*Homo Sapiens*), with brain of high capacity, erect, lofty forehead, fairly or well-formed chin; some of the men over 6 feet tall, the women a little taller than modern women.

Grimaldi Race, with full-sized brain, forehead fairly or well-formed, chin slightly receding, found at a lower level than the Cro-Magnon remains in the Mentone caves (10, pp. 81–4).

Implements—improved, with new types. Flint hand axes cease; stone largely replaced by bone and horn.

Javelin Head, split at the base for attachment of a shaft.

Birth of Art—drawings of animal forms, etc., on cave walls and some carving. Tools—chisel, graver.

Burial—apparently ceremonial; remains coloured with oxide of iron.

Fire—ashes and burnt bones found. The use of fire may have been earlier, but positive evidence appears in this period.

It has been inferred that, along with the evolution of modern features, articulate speech would develop at about this time.

Language.—Though little is known of the far-off origin of language, it is widely agreed that the beginnings are to be found in animal sounds, at first instinctive, then, under stress of emotion, becoming sex calls, infant calls, parental calls, particular sounds expressing fear, anger, etc. (which may be regarded as the beginning of words)

Column 28.

Spear Head, Needle, Harpoon. Sculpture and Engraving.

SOLUTRÈ PERIOD (Solutrean).

Sites at Solutrè (France), etc.

Cro-Magnon or Modern Man found with implements of this period, as well as of the Aurignac and La Madeleine periods.

Stone Implements.—Stonework very fine; blades of laurel leaf shape. Spearhead with tanged or shouldered form.

Bone, Horn, Ivory.—Early Harpoon, needle with perforated eye (sewing and fishing with implements apparently begin); "Baton de Commandement" of reindeer horn, bored and artistically decorated (used ceremonially ?), perhaps used for straightening arrows.

Art.—Sculpture and engraving on stone, bone, horn, etc.

The late Cave Men have been compared with the Esquimaux, who are hunters and fishermen and possess similar artistic powers.

Tradition.—Following on articulate speech, oral tradition would now arise, to pass, in later times, into written records, literature and history (col. 38).

(*Continuation of Column 27.*)

and sounds associated with particular things (the second stage of words). Following on the evolution of organs permitting of articulate speech, oral language in the fuller sense would appear.

Column 29.

Stone Saw and Lamp. Buttons. Sewing.

LA MADELEINE PERIOD (Magdalenean).

Sites—Rock Shelter of La Madeleine (France), etc.

Magdalenean Race (Cro-Magnon type); Three skeletons of small stature, from 5 feet 2 inches to 5 feet 4 inches in height.

Stone not so freely used as formerly, but the Stone Saw and Lamp appear.

Bone, etc.—Harpoon with one, then with two rows of barbs. Spear thrower, as still used by natives in America and Australia; Buttons—"tailoring was extensively practised" (skins sewn with sinews ?) (10, p. 97).

Art.—Very fine drawings, paintings on cave walls, plaques of bone, stone, etc.; carving of mammoth on reindeer horn and of reindeer on mammoth tusk; a famous relic is a piece of ivory having incised on it a hairy elephant. All these animals are thus shown to have been contemporary with man.

Sites in England.—Kents Cavern (Devonshire), where remains of several periods have been found: tools of flint and chert, bone and horn pins, awls, a needle, harpoons, etc., with remains of mammoth, woolly rhinoceros, lion, bear, hyæna, reindeer, sabre-tooth tiger, etc.

Cresswell Caves (Derbyshire) with stone and bone implements, and a piece of bone ornamented with the incised head of a horse (10, pp. 44–7).

Chart 5. III. THE HUMAN ERA

Primitive man in the later Stone, Bronze and Iron Ages

TRANSITION PERIOD.

Column 30.

Bored Harpoons. Pointers, Spatulæ, Chisels.

10,000 B.C. ?

Sites at Mas d'Azil (Pyrenees), etc.

Less is known of this than of the following periods. It marks the close of the " Cave Period," though life in caves continued to some extent through later ages.

Stone Implements—often small, as La Madeleine period, with chisel-like forms.

Bone and Horn.—Harpoons, bored for the line; pins, pointers, spatulæ (spoon-like implements).

Over 1,000 harpoons have been found at Mas d'Azil, made of staghorn, as the reindeer, from the antlers of which the earlier round-stemmed harpoons were made, had become rare or had disappeared from Southern Europe (10, pp. 106–9).

Art.—Some drawings of animal forms; curious painted marks—lines, spots, etc.—on pebbles (used for magic purposes ?).

In Australia rock paintings of game animals of a symbolic character form part of magic ceremonies by which good hunting is secured (11, p. 52).

Burial.—Ceremonial, ochre sprinkled over the remains.

Sites in Britain.—MacArthur cave, and other places in Scotland and Northern England, with harpoons, etc., as at Mas d'Azil (10, pp. 114–21).

NEOLITHIC EPOCH (New Stone Age). (The classification of this epoch is unsettled.)

Column 31.

POTTERY APPEARS. Dog probably Domesticated.

EARLY NEOLITHIC PERIOD.

8000 B.C. ?

Sites at Le Campigny (France), etc.

. . . He also discovered the bow and arrows, to make rude kettles of burned clay which we call pottery, to attach a wooden handle by lashings to his axe-head or even to bore a hole in the axe-head and insert the handle . . . the lake dwellers discovered other sources of food and became agriculturists. The grains which they planted were barley, wheat and some millet. . . . More than a hundred bushels of grain were found by the excavators on the lake bottom under the vanished lake-village of Wangen (Switzerland) (14, Chap. I).

Stone Implements, bearing resemblances to those of Magdalenean and Azilian times, hardly polished in this period.

Flint Mines worked, as at Brandon, Suffolk, where knives, scrapers, spear-heads, etc., galore have been found; and in the British Museum a pick is to be seen with a print of the miner's thumb on a piece of clay sticking to the handle (11, p. 56).

Coarse Pottery appears, which, however, may be older than this period.

Dog probably domesticated.—The existing Andamanese do not cultivate the soil and the only domestic animal they possess is the dog.

Habitations.—Caves, rock-dwellings, hearths hollowed out in the open.

Great Britain becomes an island.—In palæolithic times the beds of the North Sea, the English Channel and the Irish Sea were land areas. But from early Neolithic times nearly the whole of these tracts were covered by the sea. The submerged forests of our coasts and the Dogger Bank are remaining vestiges of these land surfaces (10, pp. 9, 101).

Column 32.

Bow and Arrow in Use. Fish-Hooks: Nets, Floats. Stone Implements Ground, Polished, Perforated. AGRICULTURE AND DOMESTIC ANIMALS. BREAD AND CLOTH APPEAR. Baskets.

LATE NEOLITHIC PERIOD.

Sites at Chassey (France), Robenhausen (Switzerland), etc.

Stone Implements polished, axes perforated for the shaft, with deer-horn socketing to mollify the effects of blows.

Bow and arrow common (it may have been in use in earlier times); spoons of baked clay; pottery with handles and ornament; baskets; fishing nets, hooks, floats.

Agriculture.—Wheat, barley, millet cultivated; also flax. Grinding stones—corn ground and bread made. Spindle whorls—cloth made.

In the British Museum are specimens of charred wheat and bread, textile fabrics, a stone knife in its original wooden handle and a stone axe in its original wooden shaft (21, p. 129).

Domestic Animals.—Ox, Pig, Sheep, Goat, Horse.

Habitations.—Caverns; Pit-dwellings; Pile-dwellings—villages or groups of huts built on piles over water or marshland as in New Guinea at the present day (21, p. 80).

Burial.—In caverns with objects deposited in the graves.

In the " Carnac Period " of the Late Neolithic the following artefacts are recorded (21, p. 96):—Axe-heads of artistic form (for religious use ?), curved knife or sickle, superior pottery, stone beads, pendants, etc.; engraving and sculpture; enormous stone tombs or temples (Megaliths). Stonehenge is assigned to the end of the Stone Age or the dawn of the Bronze Age; Trepanning, the removal of circular pieces of bone from the skull, afterwards worn as amulets or charms. (The object of this " primitive surgery " may have been to let out " evil spirits " by relieving the pressure on the brain.)

(Prehistoric)—*continued.* Advance to HUSBANDRY and CIVILIZATION

makes rapid progress in discovery and invention.

Bronze Age.

Column 33.

METALS APPEAR. BRONZE TOOLS, WEAPONS, Etc. Ships, Wagon (Wheel Invented), Mirrors, Razors, Tweezers.

From about 5000 B.C. in the Orient, 2000 B.C. in Europe.

Sites—numerous in Britain, on the Continent and in other countries.

Implements.—Partly of stone, but partly of copper and bronze (a short "Copper Age" is recognized in some localities).

Axes (simple copies of stone axes at first), sickles, chisels, gouges, hammers, pincers, awls (bone handles), flesh-hooks (saws still made of stone).

Swords, daggers, spearheads, shields, war-trumpets, bells, bucklers, horsebits.

Bronze vessels; tweezers, razors, mirrors, dress-clasps, safety-pins, hairpins, buttons.

Ornaments of gold, silver, amber, jet—armlets, pendants, necklaces, rings, brooches, ear-rings.

Some implements socketed (for the handle); objects riveted, engraved, embossed.

Moulds for casting metal.

Ships without sails.—Trade in amber and gold; much gold from Ireland, the "El Dorado of the ancient world" (22, p. 146).

Wagons or chariots (wooden wheels found).

"Ring Money" (its use as money is hypothetical).

Beakers, food vessels for the dead, cinerary urns, "incense cups," "idols." Objects not uncommonly ornamented with the cruciform pattern, a well-known solar symbol (22, p. 152).

Dwellings.—Circular huts with stone walls, wattle and daub roofs (burnt wattle and daub found).

Burial.—Under round barrows (chambered mounds), bodies unburnt, in coffins or cists, with vessels of food, implements, weapons, etc.

Rock Carvings show that the soil was cultivated, that the horse and large ships (without sails) were in use and that a form of Picture Script was in existence (22, p. 104).

Early Iron Age.

Column 34.

IRON IMPLEMENTS. Metalwork—Repoussé, Etc. Earthenware Plates. GLASS VESSELS.

From about 2500 B.C. in the Orient, 1000 B.C. in Europe.

HALLSTATT PERIOD.

Sites—Ancient Cemetery of Hallstatt (Austria), etc.

Implements.—After some centuries of transition various objects made partly or wholly of iron.

Swords (iron blade with bronze handles at first), scabbards, lances, battle-axes, armour (plates).

Files, nails, forceps, bodkins, chains.

Cauldrons, flagons, cups, buckets, plates (earthenware), glass vessels.

Girdles, diadems, etc.

Whetstones "generally worn" (Hoernes) for sharpening tools and weapons.

Dwellings.—Huts in groups (villages) in Pit, Lake or Marsh Dwellings. Pile dwellings numerous (see the list given by Hoernes, *Primitive Man*, pp. 55–6).

160 in Switzerland.
46 in Germany.
32 in France.
36 in Italy; and others.

Some of these belong wholly to the Stone Age, others to the Bronze or early Iron Age and some show transition between them.

Of Bronze and Early Iron Age graves many have been investigated—525 graves containing skeletons yielded 18 weapons, 1,543 ornaments, 37 parts of implements and 33 vessels of bronze; also 165 weapons and 42 parts of implements of iron, 6 gold, 171 amber and 41 glass ornaments, 342 clay vessels, 61 spindle whorls, whetstones, etc. (Hoernes, as above, p. 106).

Column 35.

High Development of Industrial Art—Bronze Statuary, Enamelling. Soldering. Money Appears.

LA TÊNE PERIOD; including Late Keltic Period in Britain, to Roman times.

Sites—many on the Continent and in Britain.

Implements largely of iron—adze, shears, saws, pincers, skewers, ferrules, keys (sickle-shaped), spoons, pins, loom weights, querns (hand-mills for grinding corn).

Swords with iron sheaths, helmets of iron, sword belts, chain mail, spurs, armour (complete), chariots (tires, etc., found).

Bronze collars, neck rings of iron, toe rings (found on toes of the buried dead), sacrificial bowls; enamelling, soldering.

Statuettes in Bronze.—One from Aust-on-Severn is probably a goddess (23, pp. 136–7).

Money.—Iron currency bars, as found at Glastonbury and elsewhere.

Burial, as in Yorkshire, Marne (France), in full armour, with chariots, horses, vessels of food, weapons, ornaments, etc.

The Dispersal and Migrations of Early Mankind.—Following on earlier wanderings, two later centres of multiplication and dispersal are more definitely known—

1. **The Southern Grasslands** of Arabia, from which waves of Semitic migrants (Akkadians, Canaanites, Hebrews, etc.) surged northwards;

2. **The Northern Grasslands** of Europe and Asia, from which the Indo-Europeans ("Aryans")—Medes, Persians, Greek tribes, etc.—spread southwards. From this group most European peoples have descended.

The Aryans, in their original home, according to Canon Taylor, were nomad herdsmen who had domesticated the dog, dressed in skins sewn together, knew how to kindle a fire and count up to 100. Marriage was a recognized institution but they were polygamists, and practised human sacrifice (22, p. 14).

Chart 6. III. THE HUMAN ERA (Historic).

(*a*) ORIENTAL TIMES—from about 6000 to 500 B.C.—Development, struggle and coalition of primitive tribes ment. Rise of primitive science, written law and literature.

(*b*) GREEK AND ROMAN TIMES—from about 900 B.C. to 400 A.D.—Political development, but with much slavery. organized science and philosophy.

(*c*) DARK AND MIDDLE AGES—from about 400 to 1400 A.D.—Comparative stagnation and loss of intellectual liberty in

6000 B.C.	5000 B.C.	4000 B.C.	3000 B.C.
Column 36. **BIRTH OF CIVILIZATION, in Sumeria ? Discovery of Copper.**	*Column* 37. **United Empire in Egypt. Earliest Calendar. Bronze Made and Brick Invented.**	*Column* 38. **ORGANIZED GOVERNMENT IN EGYPT. EARLIEST ALPHABET. WRITING MATERIALS. WRITTEN LITERATURE. Annals. Iron Discovered.**	*Column* 39. **FIRST WRITTEN CODE OF LAWS AND CENSUS. EARLY LIBRARIES, LITERATURE AND SCIENCE. COMMERCE, SHIPPING, PLUMBING, Etc.**
Sumerians in the Mesopotamian district.—An earlier but less known civilization than that of Egypt—Temple of Bel (Eulil) at Nippur, supposed to have given rise to the Tower of Babel stories and to be the ancestor of our church steeples. **Pre-dynastic Age in Egypt.**—Copper discovered, probably by 5000 B.C.; needles, with hook-eyes, the earliest metal implements, found in Egyptian graves dating before 4000 B.C. (13a, p. 429). **Civilization.**—The stages in the rise of mankind from the animal condition, through the wild, savage and barbarous to the civilized condition are now sketched in rough outline. Among anthropoid apes—to go no farther back—simple *Family* relations exist. With Pithecanthropus and early man grouping would proceed, and the earliest *Kinship Groups* would be formed. The increase in size of these groups would result in the formation of *Primitive Hordes*. Such hordes were probably peaceful in the main; but while living apart from one another, they would evolve different languages, customs, decorations, etc.; and when contact occurred, as they wandered in search of new food areas, they would regard each other as dangerous enemies; war in its primal form would ensue, the weaker groups being annihilated or, later, enslaved. Larger groups, *Primitive Tribes*, would thus be formed. As the more powerful tribes increased in size, under their chiefs or leaders in war, they would tend to form Incipient *Kingdoms* (16, Chap. X.).	**Egypt.**—*Pre-dynastic Age . . . 1st and 2nd Dynasties.* **Kingdoms of the North and South,** followed by the United Empire of Egypt, 4400 B.C. ? (or 3400 B.C. ?) **Picture Writing: Earliest Calendar,** 4241 B.C. (the earliest fixed date in history; 14, p. 45). Following on a short Copper Age in Egypt and other localities— **Bronze** appears, probably by 4400 B.C. Copper Mines in Sinai worked from 34th to 12th centuries B.C. **Brick** (sun-baked) appears in the early Egyptian Bronze Age. Early houses of mud, reeds, etc., began to be replaced by brick dwellings. In Egypt, according to tradition, the land was at first ruled by gods. One of these appointed his son by a mortal woman to succeed him, so that the kings came to be considered as part god and part man, and the government autocratic, without political development, the people being "serfs and bondsmen of the king." "Men lived by his grace only, and at a word from him they were slain" (24, p. 116). The ancient Egyptians were very religious; the religious and civil laws were carefully observed; but all classes were intensely superstitious and believed firmly in the existence of spirits, good and bad, witches, fiends and devils, which they tried to cajole, wheedle or placate by magical names, "words of power," etc. The magician was the real priest, to the lower classes, at least.	**3rd to 7th DYNASTIES.** **Egypt.**—K. Cheops (Khufu). **The Great Pyramid,** 3700 B.C. ? (or 29th century ?). **Earliest government with taxes** (14, p. 39). **Alphabetic Writing appears.—Pen** (a pointed stick or reed); **Ink** (water, soot and vegetable gum); and **Paper** (papyrus, a split river reed) invented (14, pp. 43–44). **Annals.**—The Palermo Stone, with year-names and lists, from about 3400 B.C. Imhotep, first physician and architect in history. **Literature.** — Medical prescriptions, a book dated about 3900 B.C. "Precepts of Kaqemna," containing admonitions on behaviour, "The Book of the Dead," apparently dating back in part to this time, containing religious and magical literature. Accounts of the Creation of Man, the Destruction of Mankind by a Deluge, etc. (24, pp. 32, 68–72). **Akkadians and Sumerians.**—The City States and their struggles, followed by the Akkadian-Sumerian Empire; Sargon I of Akkad, 3750 or 2750 B.C. (date unsettled). **Iron** appears, perhaps as early as the first dynasty in Egypt. It comes slowly into use, and is more commonly used for implements by the 18th dynasty. **Crank Drill** for boring stone—vases and **Potter's Wheel** invented about this time (13a, p. 572).	**11th and 12th DYNASTIES.** **Egypt—Code of Laws** (now lost; 14, p. 53). Census, Survey and Boundaries. **The Nobles' Libraries,** from Egyptian tombs, rolls of papyrus packed in labelled jars—stories, elementary arithmetic, beginnings of Geometry and Algebra. Simple Astronomical instruments; but the records, like some in geography, have been lost (14, pp. 76–9). **First "true" Babylonian Empire,** Hammurabi, 2100 B.C. Oldest surviving Code of Laws. School-house building and tablets containing scholars' exercises found. Gilgamesh tablets—story of the Creation, Deluge, etc. **Ægean Civilization in Crete** from about 3000 B.C. **The Canaanites drift into Palestine**—a wave of Semitic migration—and establish themselves. **Money, rings or wire.**—*Sea-going ships* before 2800 B.C., pictured in wall relief scenes in the pyramid temple of Sahure. Plumbing, carpentry, weaving and glass-making industries. Babylonian **Seeder or corn-sowing machine** (shown in use on a carved stone seal). **Wheeled cart** in use in Asia, drawn by donkeys. The horse—"the ass of the desert"—appears in civilization somewhat later. Art and Architecture. **Chinese civilization** (from 3000 B.C. ?; early history legendary).

result in the formation of the earliest nations. Autocracy, theocracy and much slavery, with little or no political develop-

Free enquiry and rationality partially replace mere subservience to tradition and superstition. Rise of true history,

the West, with relatively brilliant Arab and Chinese civilizations and learning.

2000 B.C.	1000 B.C.	B.C.-A.D.	500 A.D.	1000 A.D.

Column 40.	*Column 41.*	*Column 42.*	*Column 43.*
CIVILIZATION IN EUROPE (MAINLAND), Clock Invented.	**Political Development in Greece and Rome. Discovery of Mind. Appearance of True History, Early Organized Science, Rational Medicine and Philosophy. Coined Money Appears.**	**Decline of Rome. Wane of Intellectual Activity and Freedom. Civilization in Britain.**	**The Dark and Middle Ages in Europe. Arab and Chinese Learning. Literature Appears in Britain.**

18th to 21st DYNASTIES.

Q. Hatshepsut, of Egypt, first famous woman in history. Thotmes, first famous military general. Shadow-clock invented, 1500 B.C. ?

Assyrian Empire.—First large army with weapons of iron (14, p. 157). Iron obtained from mines worked by the Hittites in the thirteenth century B.C.

Ægeans.—Great Palace of Knossus, Crete; written records not yet deciphered. Water supply and drainage. This civilization spreads to Asia Minor (Troy), to Europe (Tiryns. Mycenæ) from about 2500 to 1200 B.C. It falls before the incoming nomadic, and at this time barbarous, Greek tribes from the north. Fall of Troy about 1200 B.C.

The Philistine City Kingdoms from about 1100 B.C.

Hebrews enter Palestine about 1400 to 1200 B.C.—another wave of Semitic migration from Arabia—and slowly overcome the more civilized Canaanites: David takes Jerusalem about 1000 B.C.

(*Continuation of Column 41.*)

for all citizens early in the third century. Fall of the Republic; the Empire from about 30 B.C.

Literature.—Virgil, Horace; Lucretius on the *Nature of Things*, early conjectural account of human progress.

Jesus of Nazareth born, 8 B.C. ? (29, April 1920, p. 103).

22nd and 26th DYNASTIES.

Egypt.—Conquered by Cambyses of Persia, 527 B.C.; falls to Greece, 332 B.C.; becomes a Roman province, 30 B.C.

Babylonia conquered by Cyrus of Persia, 529 B.C.

Assyria.—Ashurbarnipal's Library at Nineveh; cotton grown; fall of Assyria, 506 B.C.

Zoroaster, in Persia, "First founder of a great religious faith" (about 1000 B.C.). Buddha, 564–484 B.C. ? Asoka, enlightened Indian Emperor. Confucius, 551–478 B.C.

Greek City States from about 900 B.C. Disappearance of the Kings; Code of Laws, Draco, about 624 B.C.; Lycurgus, Solon, reform, early Democracy, but with large slave groups. Greece falls, 146 B.C. Coined money in Lydia, about 700 B.C.

Homer's Songs from about 1000 B.C.; Hesiod's poetry about 750 B.C. Thales, first great philosopher and scientist, about 600 B.C. True History arises (Herodotus, Thucydides); Grammar; Logic (Aristotle); Geography (Eratosthenes); Early Organized Science (Archimedes, Aristotle); Advance in Astronomy (Aristarchus); Medicine (Hippocrates); Philosophy (Plato); "Discovery of Mind" (Anaxagorus) (13, p. 73); Musical Notation, Drama and Theatre (Æschylus, Sophocles, Euripides, Aristophanes); Light, Shade and Perspective in Art (Apollodorus) and invention of small portable pictures.

Rome.—Code of Laws, the XII tables, 450 B.C. Early Democracy; equal rights

China.—Various states and dynasties; political and philosophical literature.

Rome.—Empire and autocracy; revolution, disorder, "oriental despotism" established by 300 A.D.; luxury, poverty, freemen become serfs (Coloni), cruelty, homicide as sport. Rome sacked by the Goths, end of the Empire in the West, 410–476.

Birth and spread of Christianity; heresy becomes a crime by 438 A.D. (Code of Theodosius). Lapse of intellectual freedom and activity. Wane of science and literature; but some writings appear—Pliny, natural history; Galen, medicine; Ptolemy, a Greek astronomer in Egypt, "the last famous scientist of the ancient world," 127–151 A.D.; Seneca, Epictetus, Marcus Aurelius.

Education.—The boys of the upper classes in ancient Egypt received some education and there were schools in Babylon (col. 39). In Greece the boys of citizens were educated in schools, which were at first private and afterwards often supported by the State. In Rome little was done until the second century B.C.—after the conquest of Greece—when parents began to send their children to schools opened by freed Greek slaves and something was done to establish a system of schools, but education largely disappeared from the fifth century and the "Dark Ages" began.

Britain.—Civilization brought by the Romans; invasion and conquest from 43 A.D.

Brilliant Arab Civilization and Learning.—The Arabs surged from Arabia in the seventh century (a wave of Semitic nomads), conquered Syria, Egypt, Persia, spread across North Africa and to Spain; Bagdad, the new capital, 726 A.D.; Haroun Alraschid, great caliph (associated with the "Arabian Nights"), encouraged learning; Al Kindi, "The Philosopher of the Arabs," tenth century, said to have written 200 treatises on science, philosophy, etc.

China.—Literature and philosophy. Block printing probably invented by 600 A.D.

Rome.—Eastern (Byzantine) Empire.

Britain becomes English (invasion of Angles, Saxons, etc., after the departure of the Romans, 410 A.D.) with a system of slavery.

Early Laws of the English about 690–890. If anyone sell his own countryman . . . over sea, let him pay for him according to his wer (i.e. money value).

If anyone go from his lord without leave, or steal himself away to another Shire . . . and he be discovered, let him go where he was before, and pay to his lord sixty shillings (Stubbs, *Select Charters*, in Turral's *Illustrations to British History*).

Cædmon, "First English poet," about 660 A.D. Alfred the Great in England, Charlemagne on the Continent, ninth century, enlightened rulers, foster learning and education. The latter got so far in writing as to sign his name, a very rare accomplishment outside the Church at the time (15, p. 78).

Chart 6—*continued*

(*d*) RENASCENCE AND MODERN TIMES—from about 1400 A.D.—Revival and spread of intellectual activity. Rise of modern European nations, of representative self-government. Growth of personal, political and mental freedom. Rise of modern science, spread of education, growth of humanity.

1000 A.D. 1500 A.D. 1920 A.D.

Column 44.

Rise of the Earlier Modern European Nations. Continued Arab and Chinese Learning during the Middle Ages. The Renascence in Christendom. Invention of Representative Government.

Later Persian Literature.—Omar Khayyam (1050 A.D. ?), Firdausi, Sa'di, Hafiz, poets, story writers, etc.

The Arabs in Spain (711 to 1492)—as in the East—pursue literature, science, philosophy, etc., especially from the ninth to twelfth centuries, while the rest of Europe is in comparative intellectual darkness.

China.—"Chinese Augustan Age of Literature" from about 1000 A.D., poetry, philosophy, stories, etc.

Rise and Development of European Nations and Languages after the break-up of the Roman Empire—(Germany, France and Italy, Treaty of Verdun, 843); Kingdom of Poland by 1000 or before; Norman Conquest of Britain, 1066; Turks take Constantinople, 1453; rise of Spain (Moors driven out), 1492; Switzerland practically independent, 1499.

Government by King and Great Council, largely autocratic, with serfdom, villeinage, etc., in Western Europe, and much disorder and brutality at some periods. Checks on autocratic and arbitrary procedure in England—Magna Charta, 1215, and Rise of Parliamentary Representative Government (a "British Invention," see Zimmern in 15a, Chap. VII)—first true Parliaments, 1265, 1295; France, first Parliament (States General), 1302.

Trial by Ordeal (red-hot iron, boiling water, etc.), abolished in England about 1216.

Rise of the Towns in Western Europe from about 1000, apparently about the castles or monasteries.

King John of England a vassal of the Pope (about 1200); heresy becomes a capital crime in England, 1400.

The Renascence.—Revival of philosophy, literature, art and foreshadowings of modern science in Christendom—Aquinas, Occam; Roger Bacon (science and philosophy, died about 1292); Petrarch, poet, collects Roman writings, Michael Angelo, Leonardo da Vinci ("universal genius"). Arabic numerals, including the cypher, brought from India by the Arabs.

Printing (Gutenberg, Caxton) and Paper reach Europe; Mariner's Compass (Gioja); Gunpowder (Bacon ?); but all these were probably in use in China at an earlier date. Clock with wheels and weights (tenth century ?).

Foundations of Musical Notation, about 1000 A.D. (Guido of Arezzo).

Column 45.

Development of Responsible Self-government. Growth of Liberty, Humanity, Education. Rise of Modern Science. World-Unity, World-Evolution and the World-Story.

Akbar, great Mogul Emperor (India), 1542–1605, enlightened, tolerant, patron of learning, establishes schools, etc.

Growth of Responsible Self-Government. (See Zimmern, 13a, Chap. VII.) Following on attempts to revive autocracy in England—Petition of Right, 1628; Cromwellian Revolution, 1642; English Revolution, Bill of Rights, 1689, fuller establishment of parliamentary rule. French Revolution, abolition of survivals of serfdom, self-government, the Convention, "first great popular sovereignty" in modern Europe, 1792. Prussian Constitution, 1848; Germany unified, 1870–1; Italy, first Parliament, 1860. Russia and Turkey Constitutions, 1895, 1908. Portugal, Republic, 1910. The "Meeting of East and West"—Japan, modernization, Abolition of Serfdom and Constitution, 1871–90; China, Constitutional Government, 1906, Republic, 1912.

Reform in Britain.—Middle classes enfranchised, 1832; townspeople, 1867; agricultural labourer, 1884; Manhood Suffrage and partial Enfranchisement of Women, 1918.

Growth of Freedom, Education, Rationality, Toleration, Justice, Humanity.—Slavery abolished in British and French colonies, 1834, 1848; Russian serfs emancipated, 1861; slavery abolished in the United States, 1865; villeinage ceases in England about 1600.

Intellectual Revolt and Reformation—Luther burns the Pope's Bull, 1520. Slow wane of grosser superstitions—magic, demonry, witchcraft, sorcery, etc.: in Britain the "witch terror" abates and the laws against witchcraft are repealed, 1735 (last British "witch" burnt, in Scotland, 1722); Statutes against heresy repealed, finally, 1676. Toleration, religious liberty, partial intellectual freedom in America by 1663 (15b, pp. 96–8); in Britain partial freedom of publication, 1689 (Licensing Act not renewed after the Revolution). Religious freedom and toleration, educational system, justice (freedom from arbitrary arrest, etc.) in France, following on the Revolution. Roman Catholics, Jews and Unitarians emancipated in England, 1813–1858; Liberty of the Press and of Speech largely gained by 1850.

Disappearance of Judicial Torture (use of thumbscrew, rack, etc.) in England, 1640, in other countries in the eighteenth or early nineteenth century. Hanging penalty for small felonies (thefts of five shillings in value) abolished in England, 1833; Factory Acts, 1833, etc.; Education Grants and Acts from 1833; Education for all, 1870, 1876.

Old Age Pensions, National Insurance, Internationalism, Peace Conferences (the Hague); League of Nations, following on the Great War, 1920.

Composers of Music arise (De Pres, 1440–1521), advance of modern music (Bach, Handel, Beethoven, Wagner).

Rise of Modern Literature.—Spenser, Shakespeare, Cervantes, Molière, Milton, Goethe.

The Newspaper, etc., arise.—Courant, 1621 ?; Defoe's Review, 1704; Gentleman's Magazine, 1731; the Modern Novel (Fielding, 1689–1761).

Rise of Modern Physical Science, terrestrial and celestial—Copernicus, Galileo, true view of the solar system, from 1543; Gravitation (Newton, 1666); **Spectrum Analysis and the "Chemistry of the Stars"** (Fraunhofer, Huggins); **X-Rays, Radium, Radio-activity, Disintegration and Transformation of Matter** (Röntgen, M. and Mme. Curie, Rutherford), and support for Prout's hypothesis of the evolution of the various elements of matter from one primordial substance.

Rise of Chemistry.—Following on alchemy and some discoveries by the Arabs (Stahl, Dalton, Lavoisier, Mendeleef); Ramsay discovers Helium on earth, 1895, discovered by Lockyer in the sun more than twenty years before. **Electricity** (Gilbert, Faraday).

Geology (Steno, Wm. Smith, Lyell).

Modern, Rational, Evolutionary, Biology and Medical Science (Vesalius, Harvey, Linnaeus, Lamarck, Darwin).

Prehistoric Archæology, Dawn of History, Tradition, Folklore (Boucher de Perthes, Tylor, Evan, Frazer), Grotefend, Champollion, Rawlinson—decipherment of ancient writings, etc.

Modern Psychology—evolutional, experimental—and **Sociology** (Condorcet, Comte, Spencer, Wundt).

World Unity, Evolution, Growth and Progress (Kant, Laplace, Lockyer, Huxley, Hæckel, Spencer).

Evolution, Progression, Retrogression.—Retrogression has undoubtedly occurred, but the degenerative, static and cyclic theories of life are untenable when the longer vista is contemplated; on the whole progress towards higher types has been the dominant feature; in the human race generally the series has been and still remains an upward one; social, organic and cosmic evolution prevail (Ward, *Pure Sociology*).

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